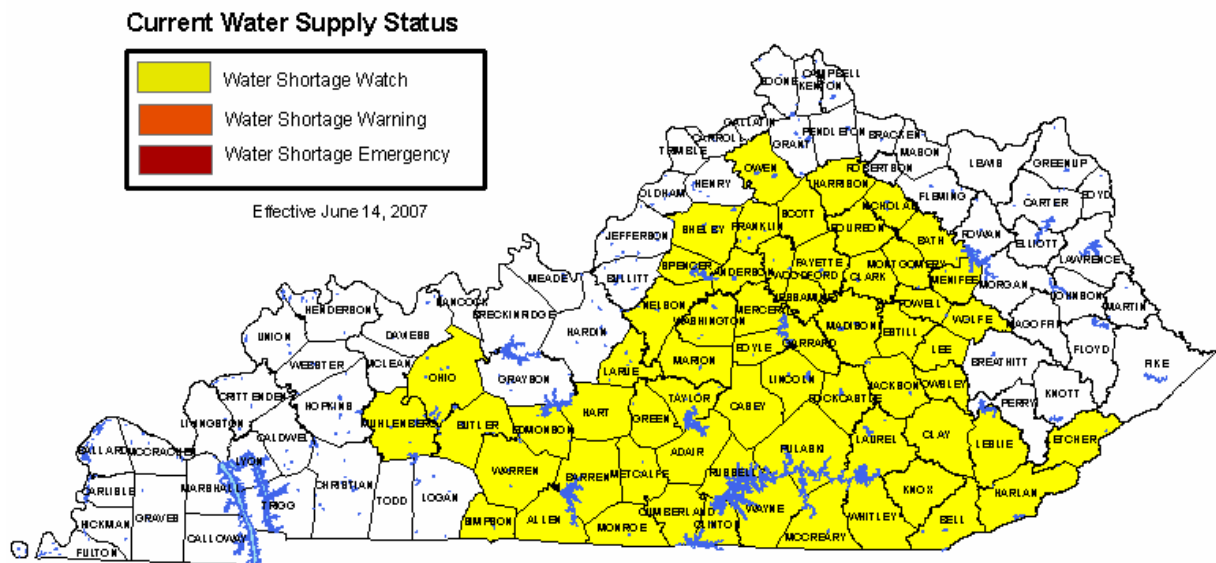


Drought

The Kentucky Division of Water continuously monitors hydrologic conditions throughout the state, including precipitation, streamflows, lake elevations and various drought indices. This information is used to detect emerging drought conditions, to identify the locations and severity of drought and to provide timely and appropriate public notification.

Kentucky Drought Monitoring Center



[Water Shortage Notification System Explained](#)

Statewide Summary of Drought Development

Current for the week of July 9, 2007

Kentucky is currently experiencing moderate to severe drought conditions as a result of a substantial deficit in precipitation that has been accumulating since November 2006. **There have been no reported shortages at water supply intakes.** With continued dry days and warm temperatures, the potential for high demands to stress the treatment, storage, or distribution of potable water is increased. Citizens in the Water Shortage Watch area should be prepared to reduce nonessential uses of water if asked to do so by their water providers.

The increased demand for water during drought can overwhelm a water supplier's ability to treat, pump or store adequate quantities of potable water. Climatic conditions of the past three weeks have favored lowered demands on water suppliers. Periods of cooler temperatures and scattered showers and thunderstorms will continue this week. If the latest predictions are correct, we will see 1 to 2 inches of rainfall by Thursday evening across Kentucky with slight to moderate improvement in our drought status. The southern and eastern areas of Kentucky appear to be in store for some of the heavier precipitation that has previously tracked further north across central Kentucky.

Useful Drought Indicators

PRECIPITATION

The Division of Water monitors a network of 24 daily climate-reporting stations to track developing shortages of precipitation. Precipitation patterns have been very favorable, bringing near-normal rainfall to the Western, Central and Bluegrass climatic divisions during the past three weeks. The Eastern climatic divisions has missed a majority of the heavier rains to date, but that could change over the next two days as wet weather returns to Kentucky. A conservative estimate of between 1 and 2 inches is expected across most of Kentucky between Tuesday and Thursday. The highest rainfall totals will likely occur in the southern parts of the state, especially in an area that includes most of southeast Kentucky and the headwaters of the Kentucky, Licking and Upper Cumberland river basins. Statewide, the combined rainfall for the months of January through June of this year ranked as the fourth driest for the period since at least 1895 -- the first year of the instrumental record.

STREAMFLOWS

Another week of numerous but scattered showers and thunderstorms provided enough runoff for slight to moderate improvement in streamflows in most areas of Kentucky. Flows are low to severely below normal once again in headwater areas in the Licking, upper Kentucky, upper Cumberland and lower Cumberland river basins. Elsewhere flows are steady and remain moderately low to low in most of the lower Kentucky, Salt, lower Licking, upper Green, Tennessee and Mississippi river basins in Kentucky. Low flow conditions are apparent in the lower mainstem of the Green River basin when these flows are compared to historical data for this time of year.

However, the amount of water flowing in the river is still substantial with more than 600 million gallons of water per day flowing near Calhoun in McClean county.

While we have yet to see the kind of widespread, soaking rains that will be necessary to alleviate hydrologic drought, the rains of the past three weeks have delayed the onset of critical low-flow conditions in many parts of central and eastern Kentucky.

LAKE ELEVATIONS

Most small water-supply lakes are not heavily impacted at this time. Lakes under the control of the [Huntington District](#), [Louisville District](#) and [Nashville District](#) of the U.S. Army Corps of Engineers continue to operate along their normal lake elevation curves. Two exceptions are the Barren River Reservoir in Barren County and Rough River reservoir in Breckinridge County. Barren River reservoir is having difficulty bringing the elevation to normal pool and is currently down by 6.0 feet. Discharges from the dam have been at or near the minimum release most of the time since March 20, 2007. Similarly, Rough River reservoir is 0.9 feet below normal pool and has been at or near to minimum release since March 16, 2007. Releases from Corps of Engineers reservoirs are important to the status of many Kentucky rivers as sources of supply for drinking water, assimilation of wastewater discharges, water quality and aquatic habitat. These rivers include the Green, Barren, Rough, Nolin, Kentucky, Salt, Licking and Big Sandy rivers.

DROUGHT INDICES

Assessing the severity of a drought is made easier with the use of drought indices that combine various source information into a single representative value of drought severity. The [Palmer Drought Severity Index](#) uses data for precipitation, temperature and evapotranspiration (the water returned to the atmosphere through the combined actions of evaporation and plant growth) to calculate a number that can be compared across different times and locations. This index was developed in the 1960's in Kansas and Nebraska but has since become a part of drought monitoring in a majority of the United States. The Palmer Drought Severity Index is updated weekly on Monday afternoons.

A second and more recent drought index is the Climate Prediction Center's Drought Monitor. The [Drought Monitor](#) represents a comprehensive assessment of several factors that contribute to the development of drought or that indicate the severity and potential persistence of drought. The Drought Monitor is updated weekly on Thursday mornings.

For the week of July 9, the Palmer Drought Severity Index indicates little change in drought status from last week in spite of some areas of very beneficial precipitation stretching from Daviess County to Pike County. **It is important to note that the Palmer Index is calculated as an average for the very large areas representing the four climatic divisions in Kentucky.** Under conditions of widely scattered showers and thunderstorms, locally heavy downpours may not be sufficient to change the Palmer Index very much when the entirety of the climatic division is considered. For example, localized areas in the Fayette-Woodford-Scott county region received up to 5 inches of precipitation in the storms of last week. However, the current Palmer Index changed only slightly (-3.14 last week to -3.07 this week). The Palmer Index is a measure of the effects of more regional

precipitation events that characterize a majority of the climatic division and should be used along with more localized indicators when assessing local drought conditions.

The Drought Monitor is updated each Thursday morning and unlike the Palmer Index, can be responsive to more localized conditions. As a drought indicator, the Drought Monitor is not limited to four large climatic division, rather it incorporates the Palmer Index as just one of several indicators of drought development in a given area. The Palmer Drought Severity Index and the Drought Monitor should be considered in combination with more localized data such as rainfall, streamflows, groundwater levels and climatic outlooks to form an accurate assessment of drought severity in a given location.

Drought Monitoring

Drought is a natural and recurring feature of our climate that can be considered a "severe" weather event much like a tornado, a flood or a hurricane. However, there are a few key differences that distinguish drought from other weather events that make it difficult to detect, track and respond to drought.

Part of the difficulty in detecting drought is in the lack of an obvious onset of drought conditions. A drought develops slowly and can appear to mimic a normal spell of dry weather in the summer, a time of the year when dry weather is accepted and expected. Short-term rainfall shortages create problems for agricultural crops, livestock, urban landscapes and other activities that depend on stored soil moisture between rainfall events. We are accustomed to dealing with short-term dry spells in part because there is an expectation that rainfall is just around the corner. However, when rainfall shortages persist for weeks or months at a time, activities that depend on long-term storage of water will be adversely impacted as well. Droughts in Kentucky can have serious negative consequences for drinking water supplies, energy production, commercial and industrial operations, recreation and aquatic habitat.

The negative impacts of drought cannot be avoided but there are ways to reduce them to a manageable level. All water suppliers in the commonwealth should have a water shortage response plan to guide both the supplier and customer during a drought event. It is important for customers to listen to their water suppliers and be ready to take necessary actions to prevent a water shortage problem from developing. This is critical to a successful outcome because the only way to effectively manage the source of water supply is to first manage the demand for water.

There is no easy method for determining when a dry spell has become a drought, how long a drought will persist or how intense a drought may become. However, by closely tracking certain sources of information, referred to as drought indicators, it is possible to detect potential drought development early enough to allow at least some lead-time for notification and initiation of drought response preparations at the local level. The Division of Water monitors for the potential development of drought in Kentucky by tracking precipitation, streamflows, lake levels, groundwater and water

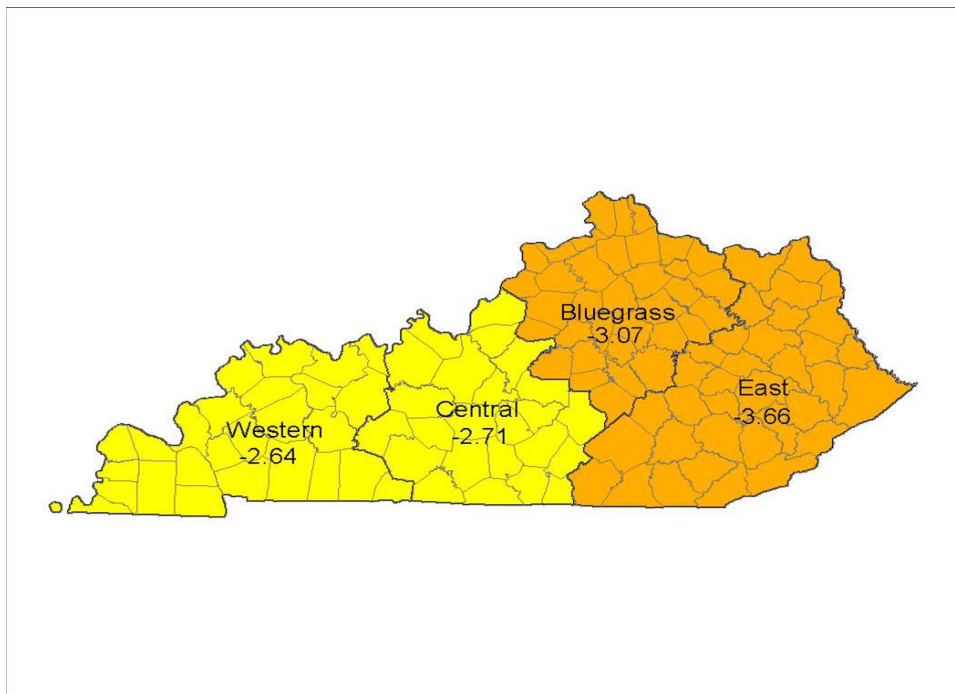
supplies. There are also several tools that are useful in assessing the severity of a "dry spell" and the potential impacts to agriculture, forest fires, water supplies and other vulnerabilities to drought. These tools include the Palmer Drought Severity Index, the Drought Monitor, the Standardized Precipitation Index and several others.

The Drought Monitoring pages will be updated on a weekly basis to provide timely information and assessments of current drought conditions in Kentucky. There will also be numerous links to other resources and drought information pages from various state and federal agencies.

Current for the week of July 9, 2007

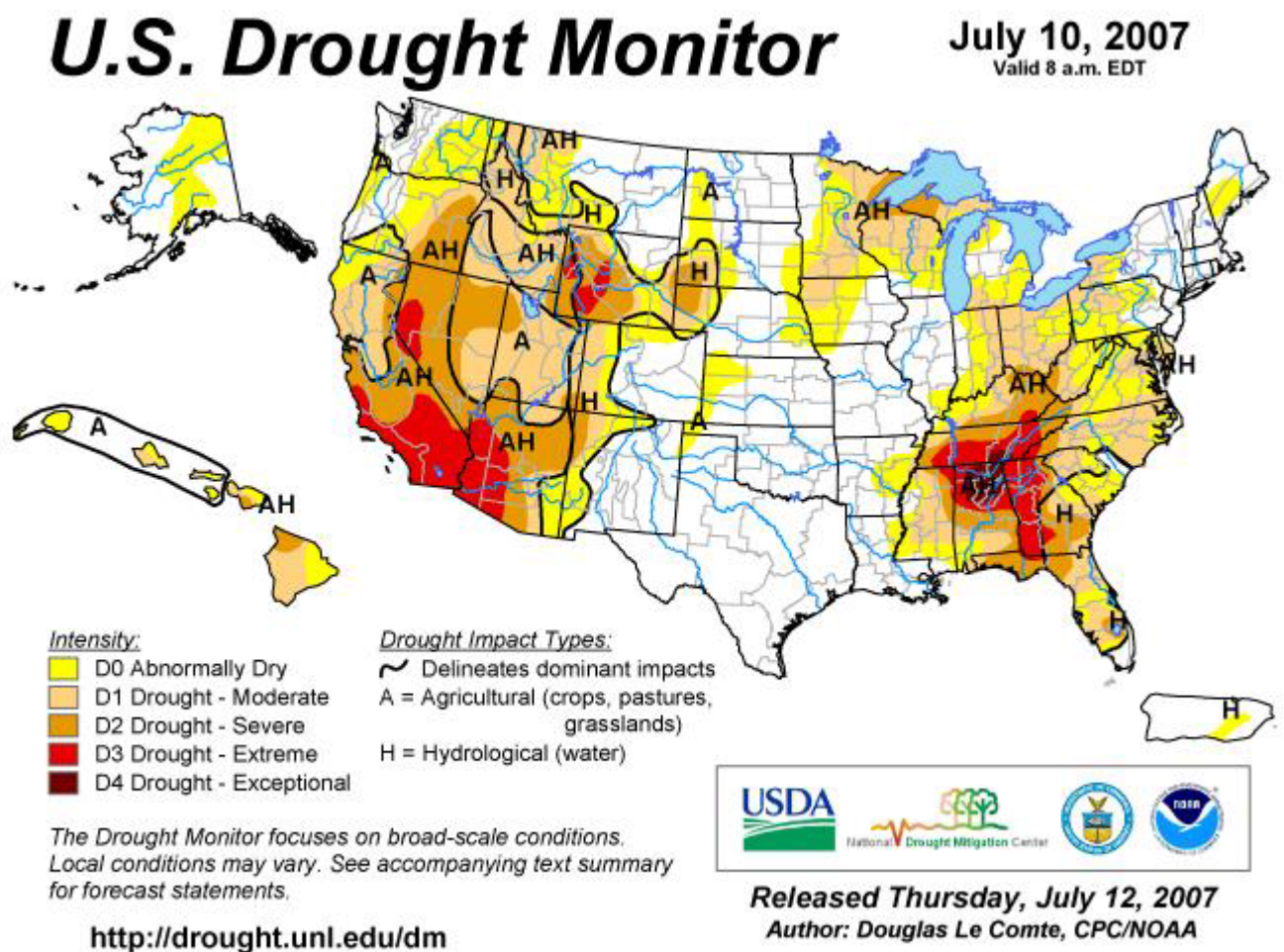
Palmer Drought Severity Index The Palmer Drought Severity Index (PDSI) is compiled weekly by the Central Region Climate Prediction Center (National Centers for Environmental Prediction, National Weather Service and National Oceanic and Atmosphere Administration) and provided on the University of Kentucky Agricultural Weather Center's Web site. This index is useful for placing a developing drought into context with past droughts and serves as a measure of current conditions. The index also provides a standardized assessment of developing drought conditions that can be compared between different areas of the state or even between different states.

PDSI values can be categorized as follows:



- 0 to -0.99 = near normal
- -1.00 to -1.99 = mild drought
- -2.00 to -2.99 = moderate drought
- -3.00 to -3.99 = severe drought
- -4.00 and below = extreme drought

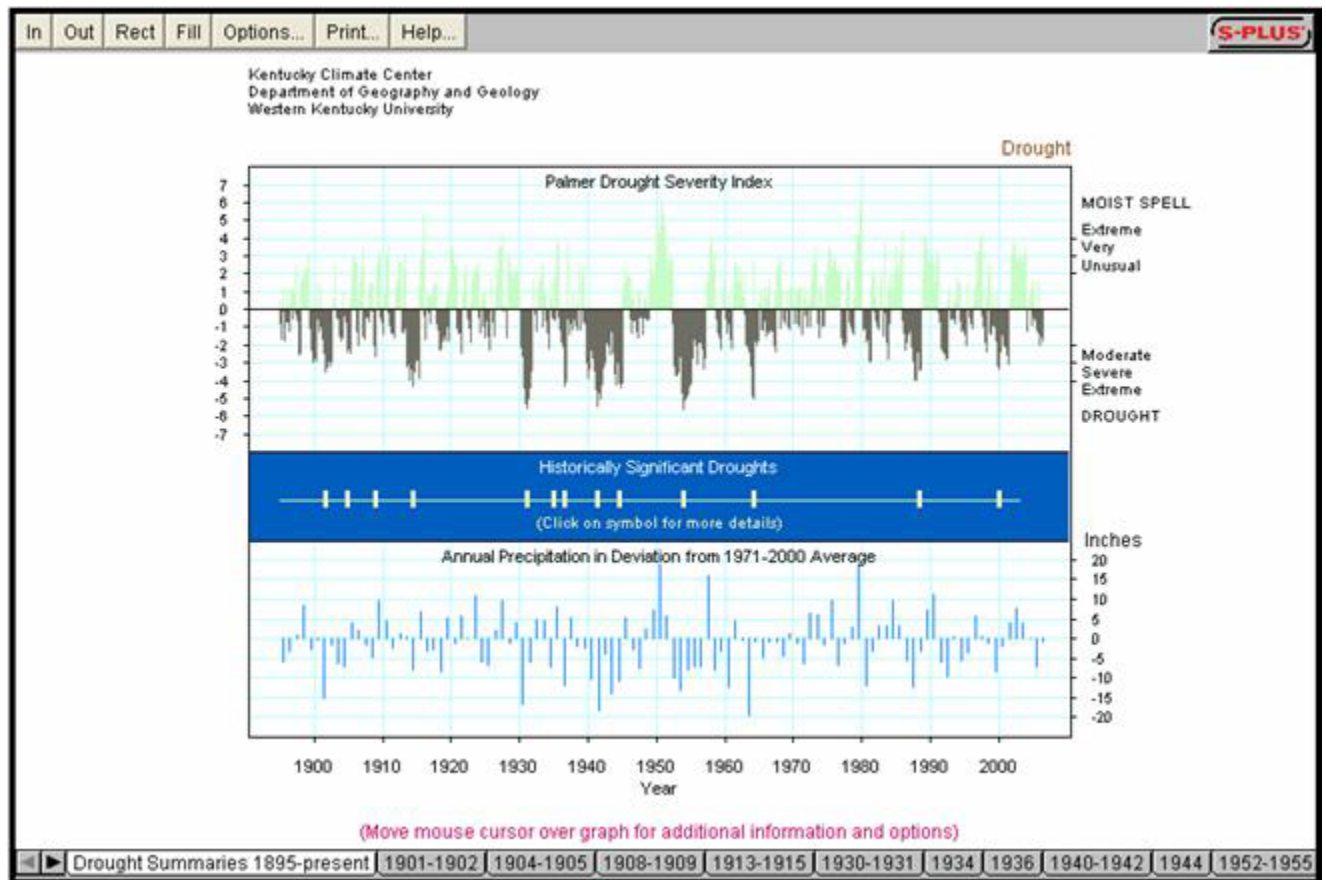
The Drought Monitor



Tracking drought blends science and art. No single definition of drought works for all circumstances, so people rely on drought indices to detect and measure droughts. But no single index works under all circumstances, either. The Drought Monitor is a synthesis of multiple indices, outlooks and news accounts, that represents a

consensus of federal and academic scientists. A detailed description of the parameters used to create the Drought Monitor can be found [here](#).

[Kentucky Climate Center](#) Historical Drought Data

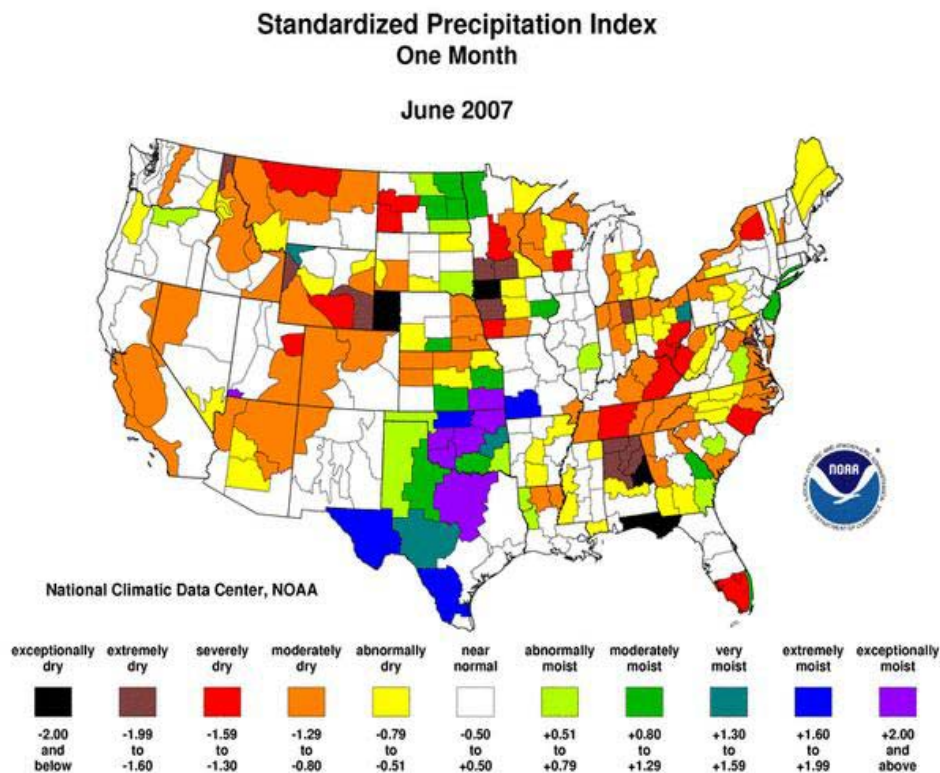


Interactive graphs displaying drought indices since 1895 for Kentucky's four climate divisions. Users can identify and explore the development of historically significant droughts.

Examining the past can be a useful tool in interpreting the significance of a developing drought situation. Comparisons of the current drought to the historical record provide a frame of reference for evaluating how serious the current drought has become, and how it might develop in the coming months. One of the best tools to evaluate past droughts is found at the Kentucky Climate Center at Western Kentucky University. Click on the figure at the left to visit this site and learn more about the history of drought in Kentucky.

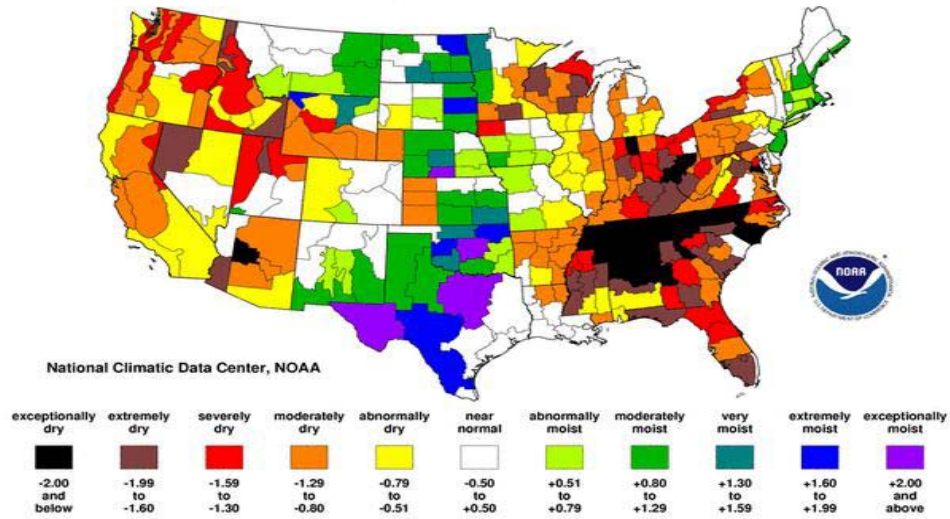
The Standardized Precipitation Index

The Standardized Precipitation Index (SPI) is a way of measuring drought that is different from the PDSI. Like the PDSI, this index is negative for drought and positive for wet conditions. But the SPI is a probability index that considers only precipitation, while Palmer's indices are water balance indices that consider water supply (precipitation), demand (evapotranspiration) and loss (runoff).



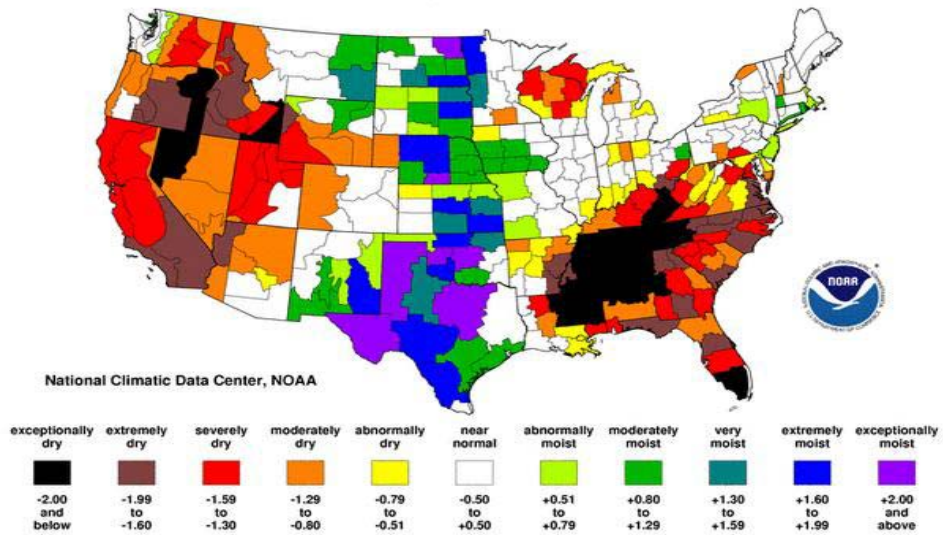
Standardized Precipitation Index Three Months

April-June 2007

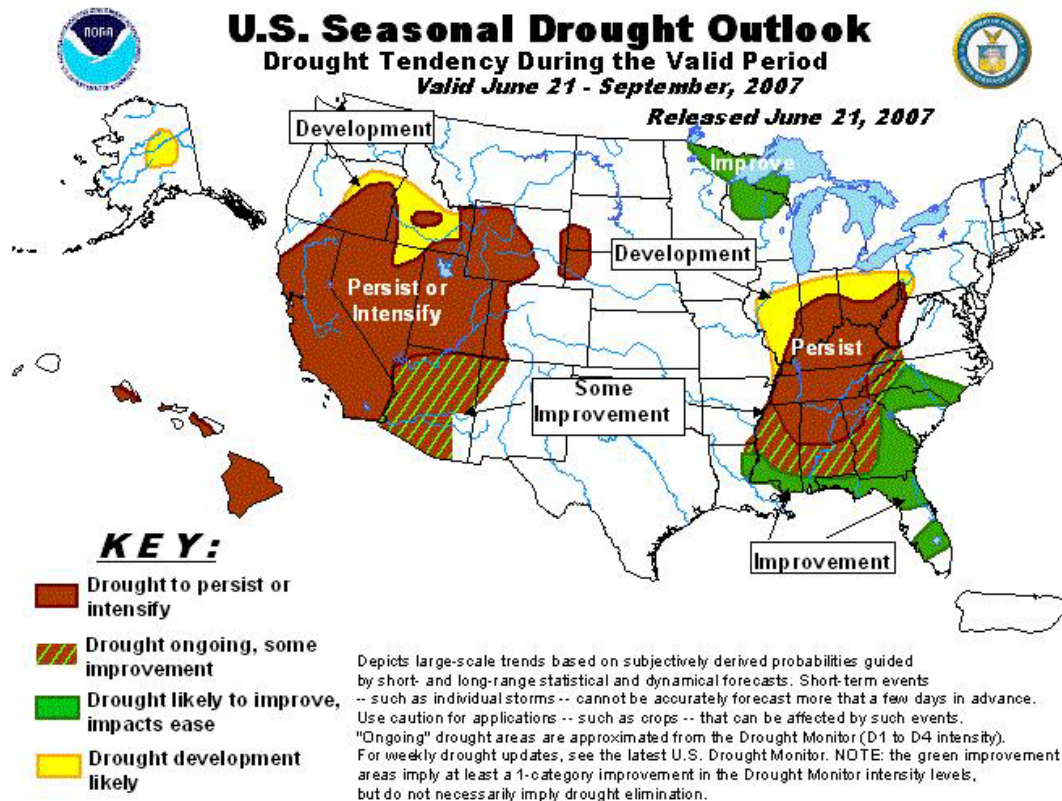


Standardized Precipitation Index Six Months

January-June 2007



U.S. Seasonal Drought Outlook



The Climate Prediction Center issues the U.S. Seasonal Drought Outlook each month in conjunction with the release of the long-lead temperature and precipitation outlooks.

Weather and Climate

PRECIPITATION

Current for the week of July 9, 2007

(Click on images to enlarge)

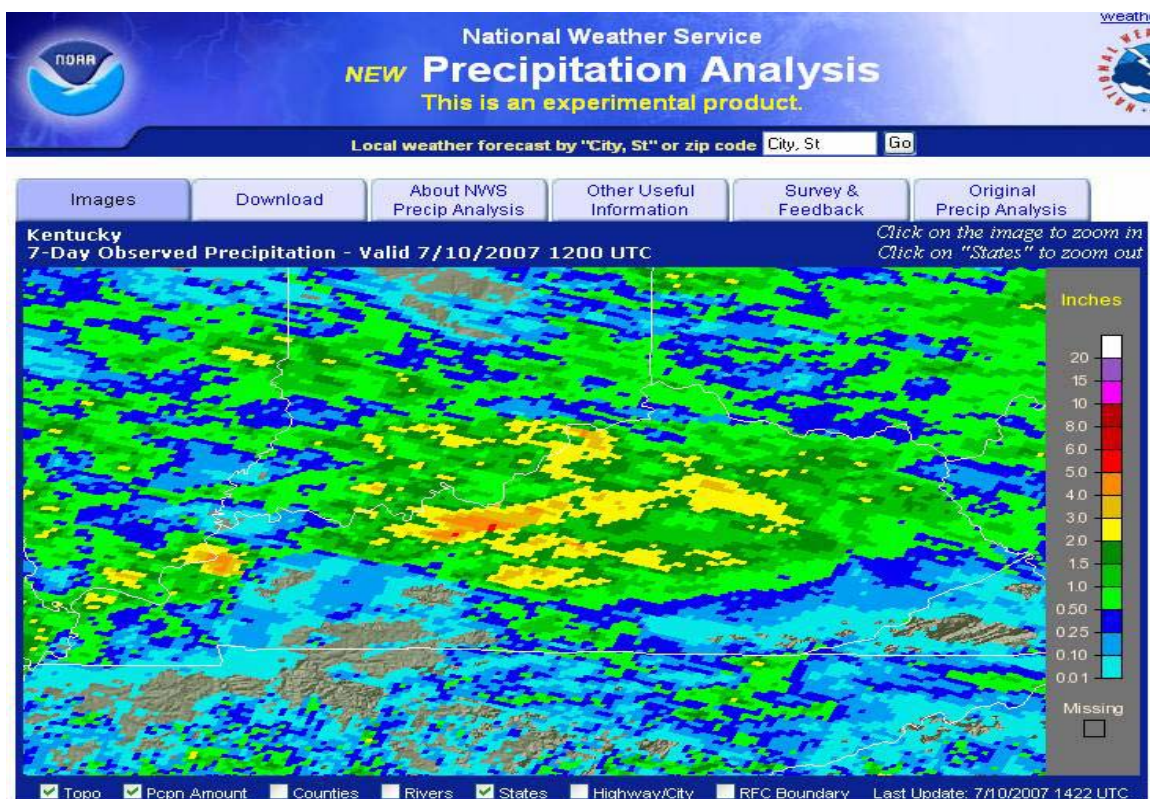
Precipitation: Data for the previous 30/60/90-day period and the Water Year Beginning October 01, 2006

Station	Water Year		30/60/90 Day Total Precipitation and Departure From Normal					
	Precipitation Totals (inches)	Departure From Normal (inches)	30 Day Total (inches)	30 Day Departure (inches)	60 Day Total (inches)	60 Day Departure (inches)	90 Day Total (inches)	90 Day Departure (inches)
Henderson	32.27	1.35	1.29	-3.28	5.88	-2.85	9.26	-4.06
Paducah	33.68	-1.04	2.32	-2.63	5.75	-4.04	8.72	-5.87
Princeton	30.11	-6.18	2.05	-2.88	5.96	-3.64	8.32	-6.07
Mayfield	27.58	-10.52	0.60	-4.16	3.85	-5.93	5.75	-9.21
Louisville	30.34	0.04	1.19	-3.26	6.33	-2.39	9.31	-3.87
Bardstown	27.05	-2.41	0.61	-3.84	5.24	-3.16	8.62	-3.98
Hardinsburg	29.47	-4.05	1.24	-3.48	5.51	-3.58	7.82	-5.70
Campbellsville	29.07	-6.24	1.69	-3.51	7.53	-2.45	11.86	-2.88
Nolin Lake	30.33	-5.12	3.35	-1.90	8.12	-1.79	10.49	-3.60
Glasgow	27.72	-8.33	1.38	-3.63	6.30	-3.32	9.49	-4.98
Bowling Green	25.25	-10.23	2.58	-2.26	6.60	-2.63	7.55	-6.52
Covington	24.60	-3.06	0.92	-3.31	3.46	-4.58	6.07	-6.02
Williamstown	32.10	2.93	1.80	-2.53	5.99	-2.51	12.43	-0.56
Spindletop	21.72	-7.66	1.30	-3.07	4.69	-3.63	7.17	-5.35
Lexington	26.89	-2.48	2.22	-2.14	5.96	-2.35	8.75	-3.76
Dix Dam	24.47	-6.36	1.26	-3.38	5.62	-3.30	9.45	-3.70
Berea	24.11	-6.60	1.49	-3.28	5.69	-3.41	9.30	-3.93
Grayson	24.78	-2.65	1.82	-2.06	5.34	-2.71	8.35	-3.19
Jackson	21.76	-9.63	1.88	-2.52	4.27	-4.27	5.67	-7.06
Quicksand	20.38	-11.12	1.87	-2.65	4.21	-4.45	5.60	-7.24
Buckhorn Lake	18.13	-12.27	0.63	-3.51	3.84	-4.09	6.00	-6.04
London	21.97	-9.18	0.96	-3.29	5.88	-2.32	6.66	-5.77
Somerset	26.75	-7.78	1.30	-3.80	5.31	-4.23	7.63	-6.30
Cumberland Gap	20.80	-14.40	0.30	-4.44	4.62	-4.30	7.75	-5.93

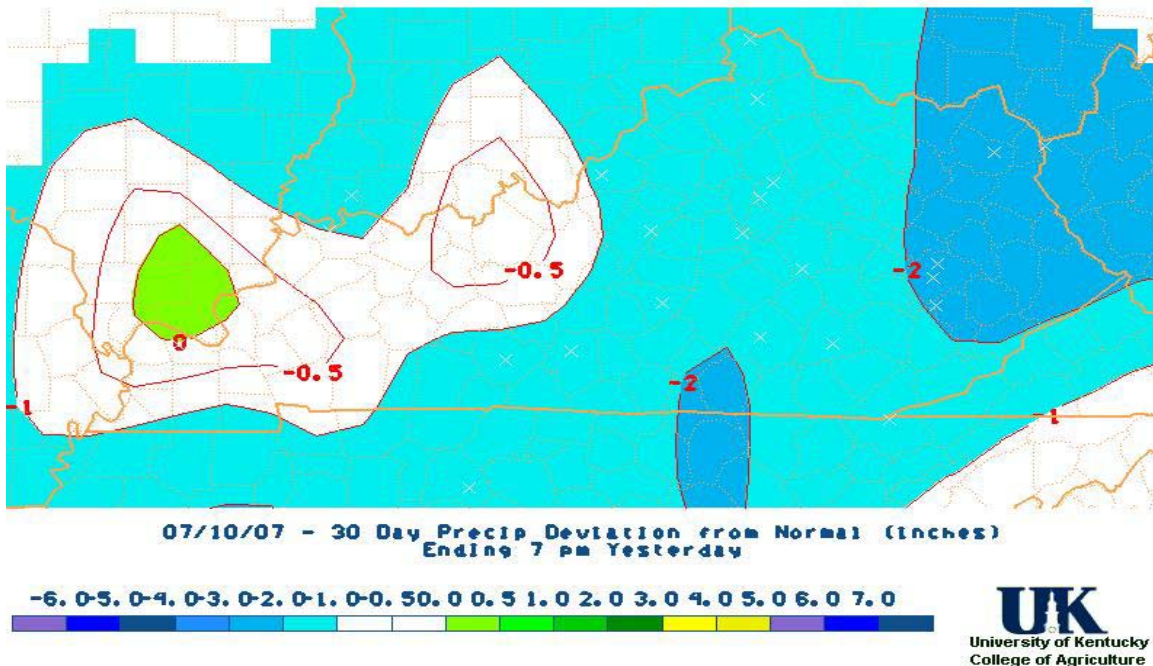
Climatic Division	Normal Precip. Water Year	Normal Precip. Calendar Year	Percent of Normal Precipitation				
			Water Year	Calendar Year	30 Day	60 Day	90 Day
Western (1)	38.83	26.58	90	76	93	60	67
Central (2)	37.73	26.08	85	79	84	58	75
Bluegrass (3)	33.39	23.28	86	80	86	53	66
Eastern (4)	35.70	24.70	68	61	59	40	55

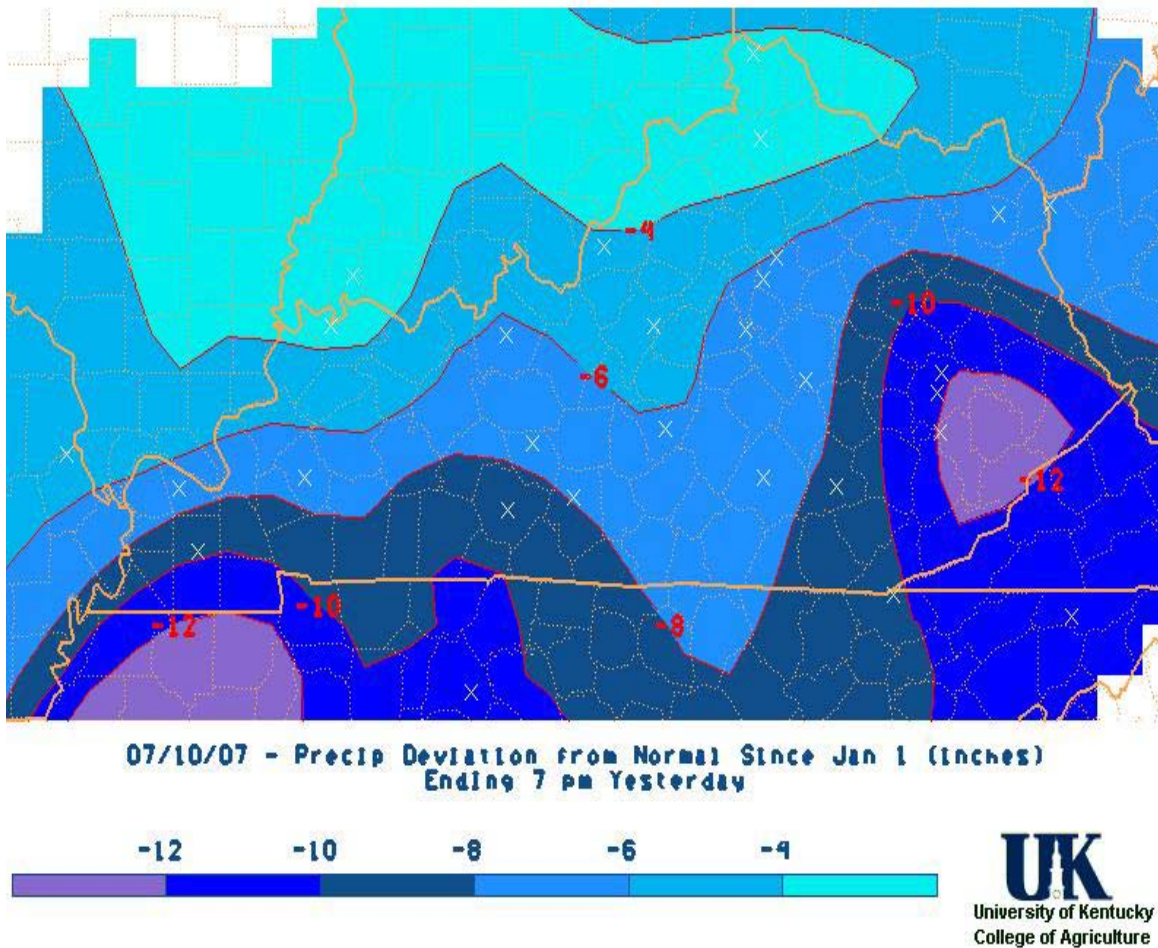
The Division of Water monitors a network of 24 daily climate-reporting stations to track developing shortages of precipitation. Precipitation deficits for the year range from 61 percent of normal in the Eastern climatic division to 80 percent of normal in the Bluegrass climatic division. Precipitation patterns have been very favorable, bringing near-normal rainfall to the Western, Central and Bluegrass climatic divisions during the past three weeks. The Eastern climatic division has missed a majority of the heavier rains to date, but that could change over the next two days as wet weather will return to Kentucky. A conservative estimate of between 1 and 2 inches is expected across most of Kentucky between Tuesday and Thursday. The highest rainfall totals will likely occur in the southern parts of the state, especially in an area that includes most of southeast Kentucky and the headwaters of the Kentucky, Licking and Upper Cumberland river basins.

Kentucky's short-term precipitation status continues to improve, especially in the western half of the state. For the most recent 30-day period, measured precipitation has reached 93 percent of normal in the Western climatic division. The Central and Bluegrass climatic divisions have improved to about 85 percent of normal, while the Eastern climatic division still lags behind with about 60 percent of normal precipitation for the past 30 days. Statewide, the combined precipitation for the months of January through June of this year ranked as the fourth driest for the period since at least 1895 -- the first year of the instrumental record. A recurrence of beneficial rains and somewhat cooler temperatures should continue to slow, and in some cases reverse, the rate of drought development.

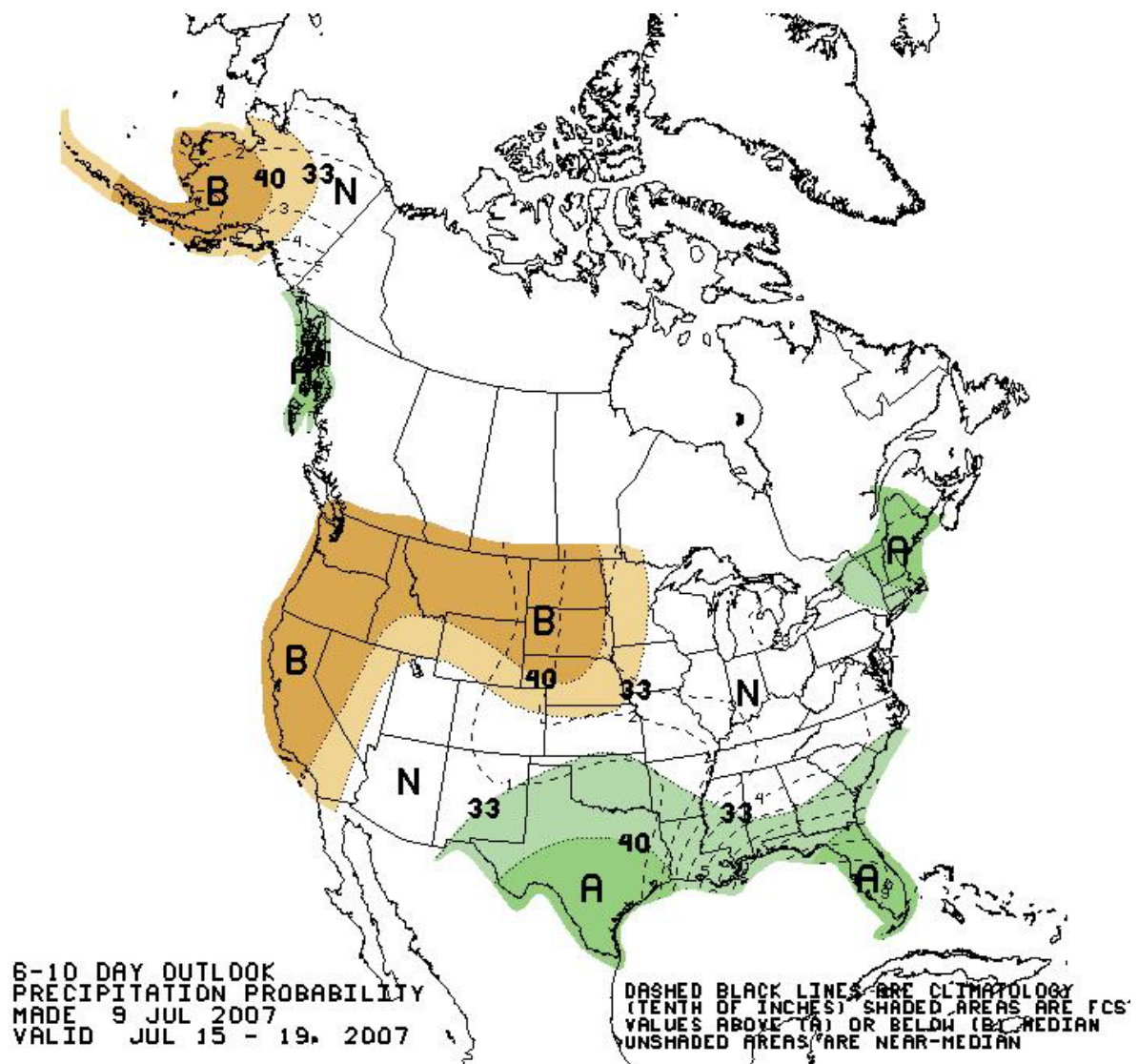


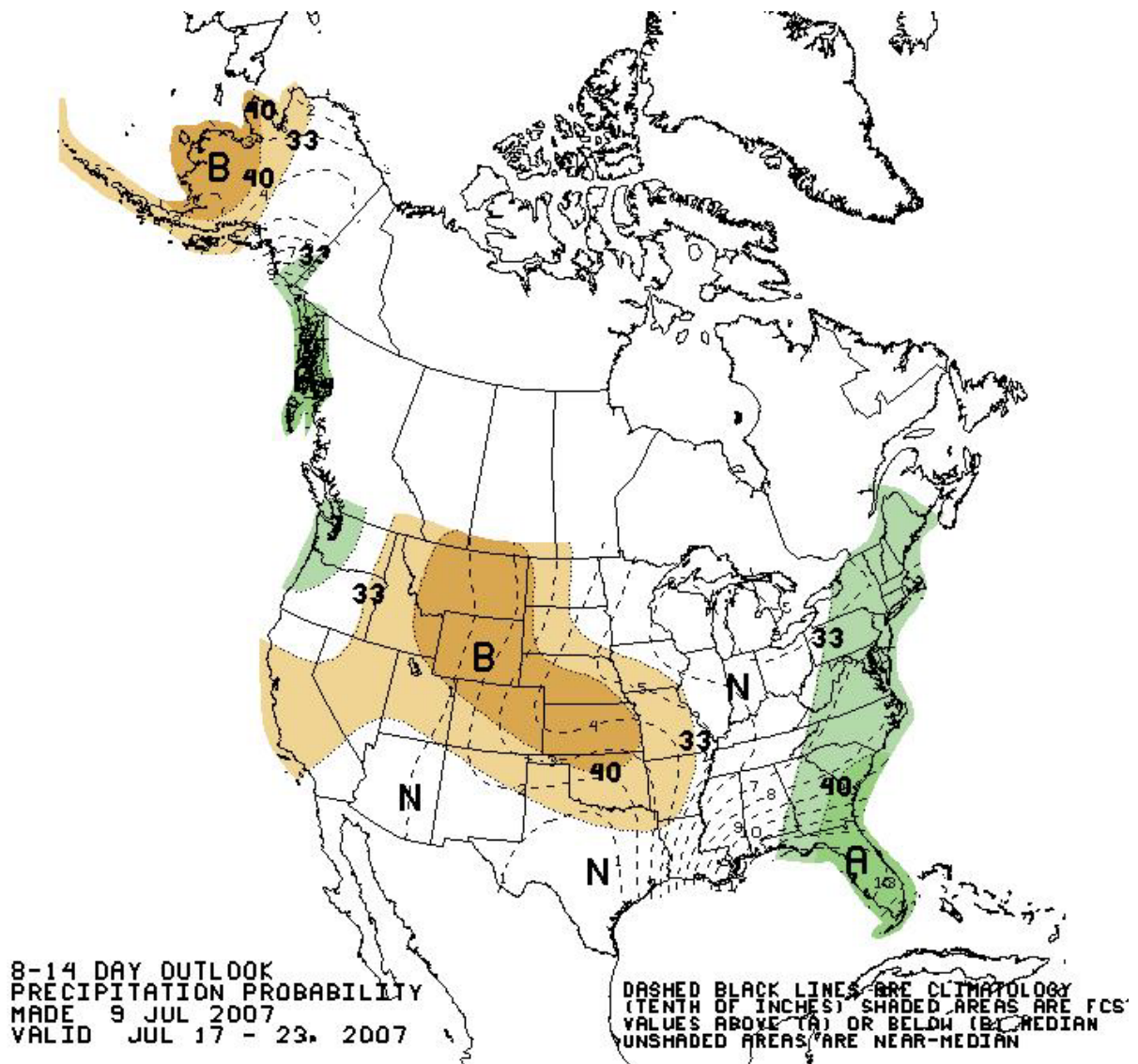
ATTENTION: One of the best tools to assess the amount and distribution of precipitation in Kentucky is the National Weather Service's [Precipitation Analysis Product](#). Data can be displayed for many different time frames and can be selected to show not only the amounts, but also the deficits and percentages of normal for each time frame.





As of July 9, 2007, the precipitation deficit for the past 30 days ranges from 1 to 2 inches below normal across much of eastern and central Kentucky. Most of the Western climatic division had near-normal precipitation in the past 30 days. For the year, the largest deficits remain in the southern portions of the Western and Eastern climatic divisions. Six to 10-inch deficits in precipitation persist in parts of the Purchase area of the west and the headwaters of the Kentucky, Licking, Cumberland and Big Sandy river basins in the east. Deficits up to 12 inches persist in an area centered around Knott, Breathitt, Perry and Letcher counties in headwater regions of the Kentucky and Licking river basins. Central and northern Kentucky deficits range from 2 to 4 inches in the extreme north and 4 to 6 inches in the Bluegrass and parts of south-central Kentucky.





Short-term outlooks from the Climate Prediction Center continue to indicate normal chances for precipitation during the next two weeks. This week's expected rainfall will certainly put a dent in agricultural and urban drought (lawns and landscaping). Deeper drought that impacts streamflows, groundwater levels, spring discharges, and lake levels will remain, but as in past weeks, slight improvement can be expected and possibly reflected in drought indices like the Palmer Drought Index or the Drought Monitor. Looking ahead, the outlooks for the next one to three months are unremarkable and indicate equal chances for below normal, normal and above normal rainfall for the state. Given the rainfall deficits that have developed with the first half of 2007, the probability of ending the drought within the next few months is

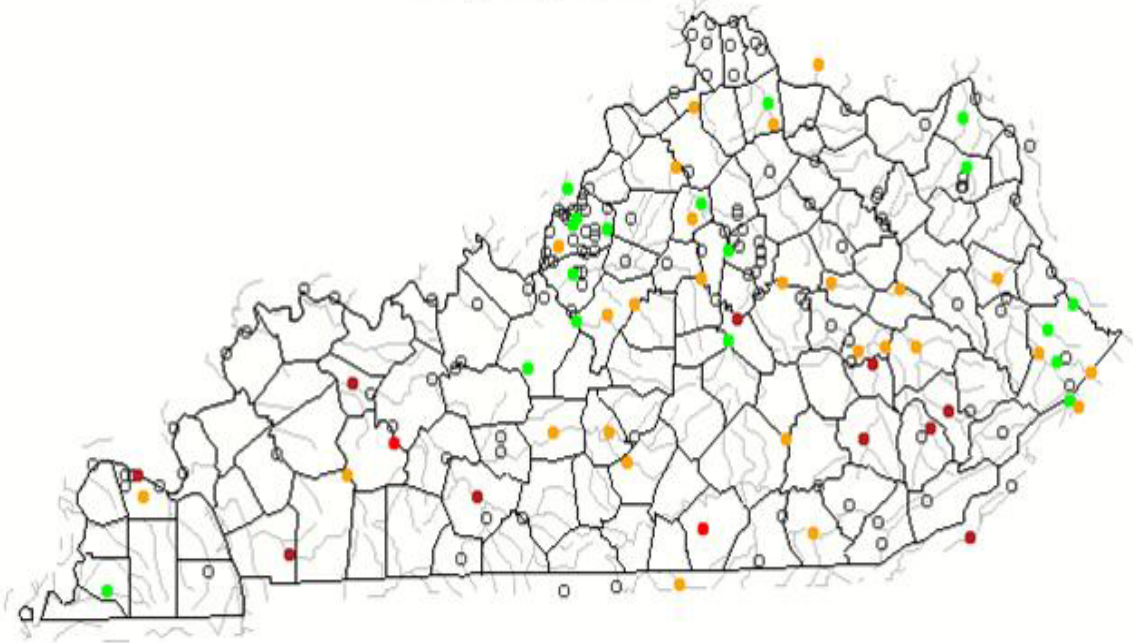
quite small. However, typical summertime weather systems can provide enough rainfall to keep extreme drought at bay until more widespread relief comes our way.

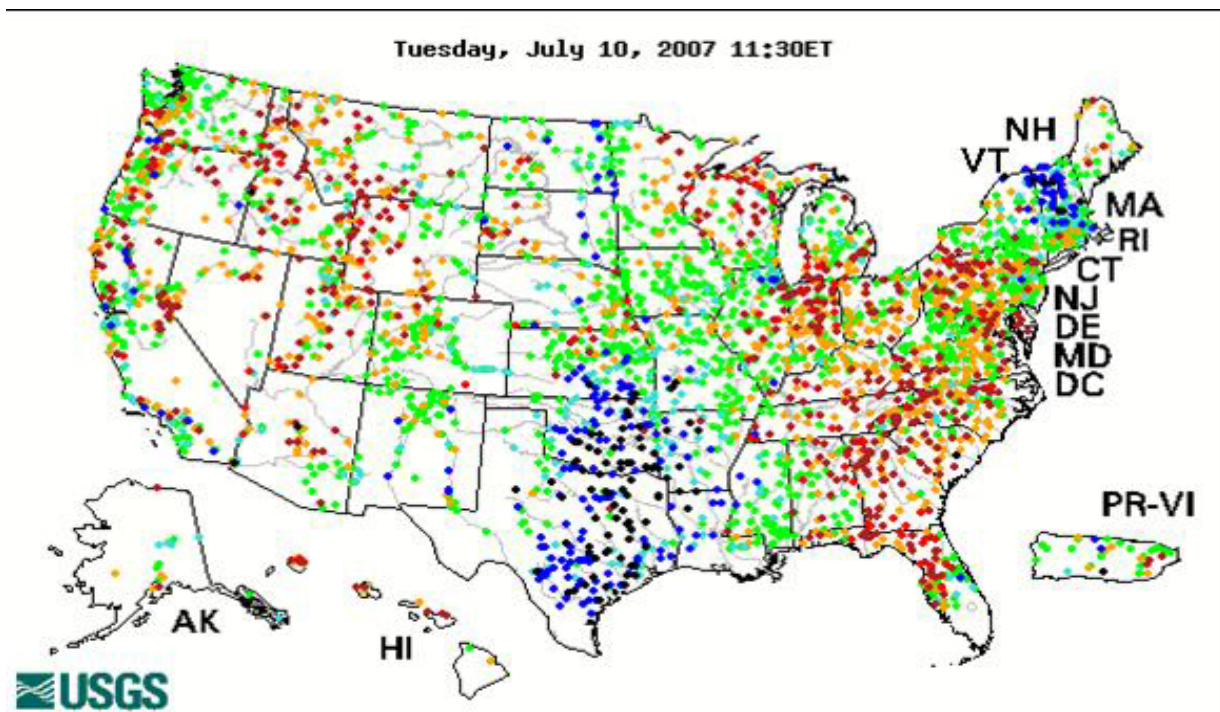
Hydrology

STREAMFLOWS

Current for the week of July 9, 2007

Tuesday, July 10, 2007 11:30ET





The [U.S. Geological Survey](#) maintains a [real-time stream gauging network](#) that monitors flows in all major river basins in Kentucky. Measurements of streamflow are a very good indicator of the longer-term hydrologic impacts of drought. During the developing stages of drought, streamflows provide valuable information on the severity and regional extent of emerging problems. Streamflow data is evaluated relative to the long-term record to determine drought intensity and identify potential problems associated with water shortages. Once a drought has matured, streamflow measurements are critical at many locations where water withdrawals have the potential to cause adverse environmental impacts to streams.

A third consecutive week of numerous but scattered showers and thunderstorms provided enough runoff for slight to moderate improvement in streamflows in most areas of Kentucky. Near-normal to normal flows for this time of year are observed in most areas of the Big Sandy, Little Sandy and Tygarts river basins. Flows are low to severely below normal once again in headwater areas in the Licking, upper Kentucky, upper Cumberland and lower Cumberland river basins. Elsewhere flows are steady and remain moderately low to low in most of the lower Kentucky, Salt, lower Licking, upper Green, Tennessee and Mississippi river basins in Kentucky. Low flow conditions are apparent in the lower mainstem of the Green River basin when these flows are compared to historical data for this time of year. However, the amount of water flowing in the river is still substantial with more than 600 million gallons of water per day still flowing near Calhoun in McClean County.

The climatic conditions (periods of cooler temperatures and modest rainfall) of the past three weeks have been ideal for keeping drought development in check. Short of a drought-buster in the form of a tropical storm or large stalled front across Kentucky, we are fortunate that more typical summer precipitation patterns have

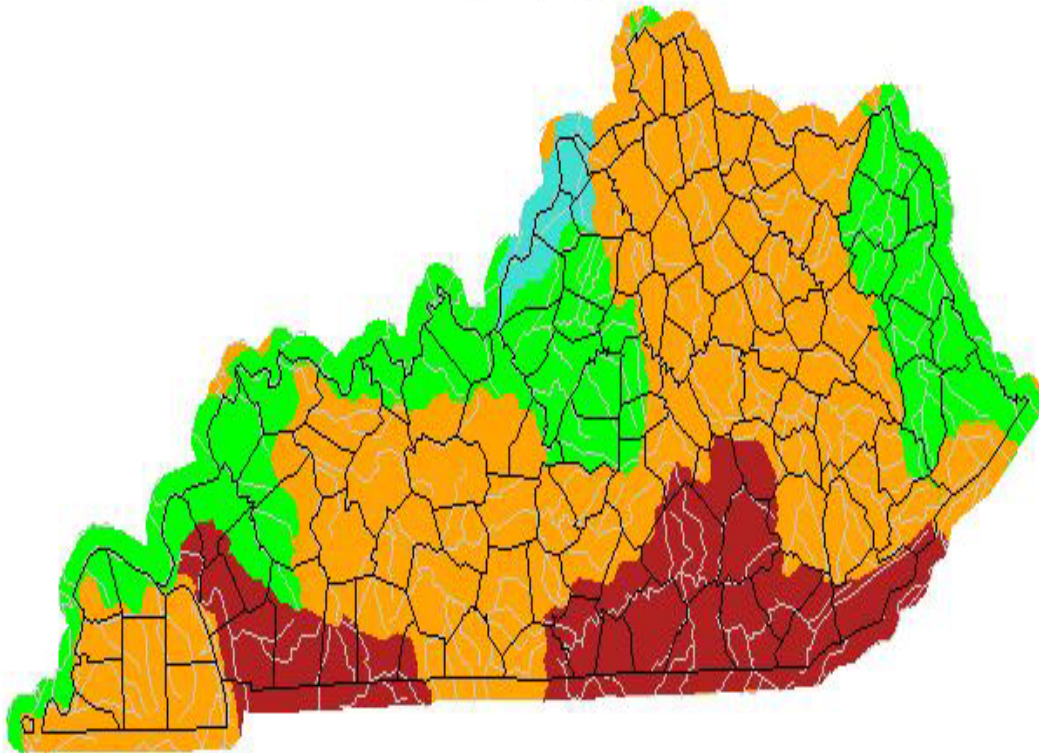
returned. While we have yet to see the kind of widespread, soaking rains that will be necessary to alleviate hydrologic drought, the rains of the past two weeks have delayed the onset of critical low-flow conditions in central Kentucky.

Weekly and Monthly Streamflow

For a slightly longer-term perspective of streamflow conditions across Kentucky, the United States Geological Survey computes average flows for the previous seven, 14 and 28 days. The resulting average streamflow values are categorized relative to the long-term record and assigned levels of severity based on the frequency that similar magnitudes of low flow have occurred in the past. By averaging over a period of several days to several weeks, the values on the map are more indicative of longer-term conditions than daily average or real-time streamflow measurements.

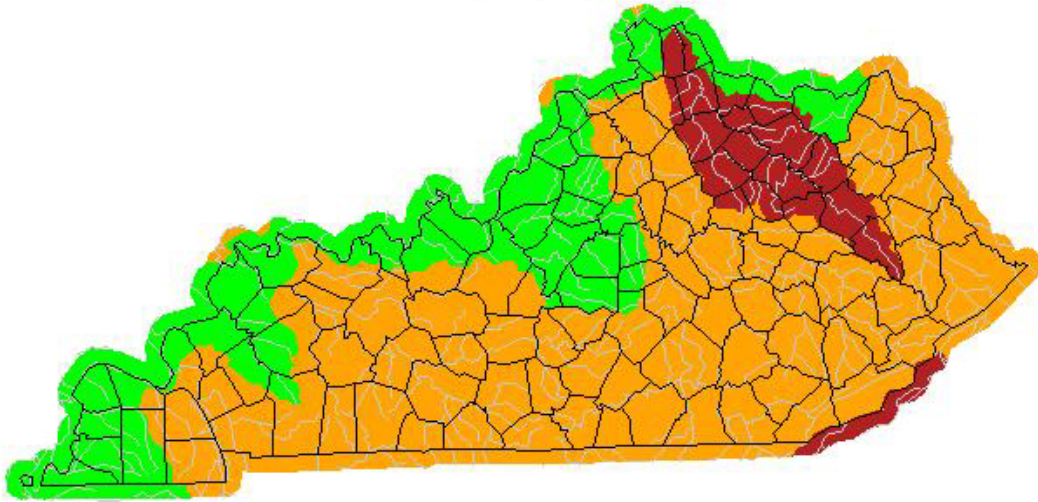
Seven-Day Average Streamflow

Monday, July 09, 2007



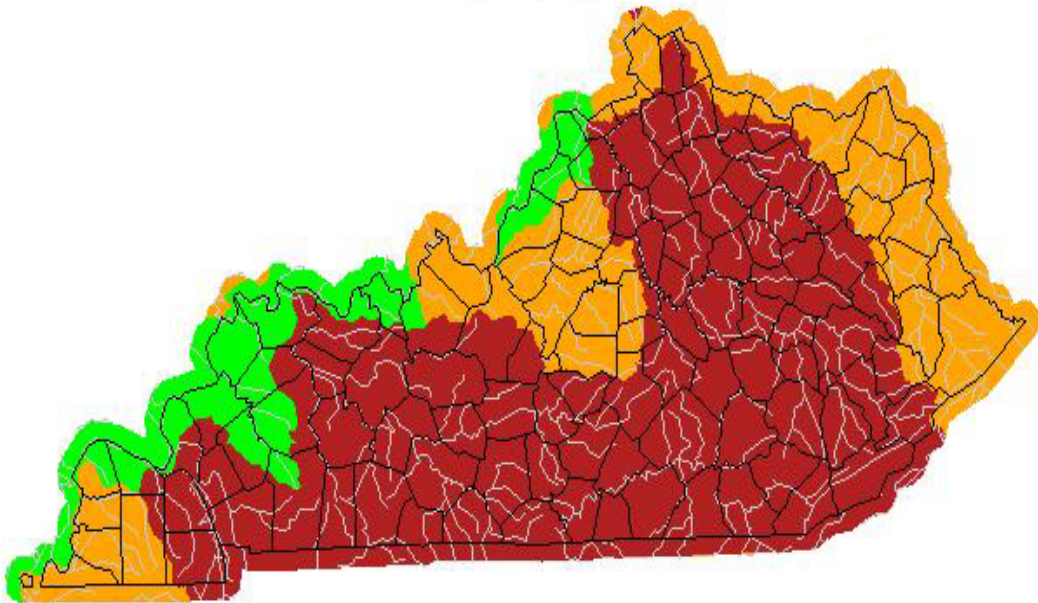
14-Day Average Streamflow

Monday, July 09, 2007



28-Day Average Streamflow

Monday, July 09, 2007



Substantial improvements in average streamflow for the past seven and 14 days is evident across most of Kentucky. Longer 28-day averages remain well below normal

for a large portion of Kentucky except for some regions adjacent to the Ohio River including the Purchase region, Tradewater and Salt river basins, and far eastern Kentucky including the Tygarts, Little Sandy and Big Sandy river basins.

The effects of spotty and sometimes intense summer storms on streamflows are generally short-lived and may do little for the overall hydrologic drought. Even in normal years, a majority of precipitation in the summer months either runs off into streams, evaporates or is used by plants and returned to the atmosphere, leaving only a small amount to replenish the groundwater "bank" that sustains streamflows during dry spells. The runoff component of summer storms becomes a key contributor to the overall flow in a stream. Thus, while spotty and scattered rains may not end a drought, they are still critical to maintaining adequate flows until more general and widespread relief arrives.

Lakes and Reservoirs U.S. Army Corps of Engineers Projects

Another useful measure of the impact that drought is having on a region is the status of area lakes and reservoirs. The Division of Water monitors data from 12 projects operated by the U.S. Army Corps of Engineers (USACE) from three USACE districts: [Louisville](#), [Huntington](#) and [Nashville](#). These projects strive to maintain reservoirs at pool levels consistent with the operating guidelines as part of the larger mission of flood control and navigation in the Ohio and Mississippi rivers. Beginning in April, the releases from the reservoirs are managed to allow filling to the "normal summer pool elevation." Significant precipitation deficits in the basin above the reservoir can adversely affect the attainment of normal summer pool elevation. This, in turn, may result in low flows in the river below the project when releases from the reservoir are reduced to the minimum needed for water quality and aquatic habitat.

By examining the data for "current pool elevation" and "current outflow," valuable information about the status of large headwater areas above the USACE reservoirs can be obtained.

**United States Army Corps of Engineer Reservoir Information
Updated July 9, 2007**

July 10, 2007

Basin	Project	Current Outflow (cfs)	Normal Summer Pool Elevation (ft)	Current Pool Elevation (ft)
Little Sandy	Grayson	25.5	645	643.8
Big Sandy	Dewey	31.7	650	650.7
	Fishtrap	76.3	757	756.5
	Yatesville	24.9	630	630.0
	Paintsville	11.3	709	709.0
Licking	Cave Run	50.0	730	730.0
Kentucky	Carr Creek	5.0	1027	1027.2
	Buckhorn	40.0	782	782.0
Salt	Taylorsville	32.0	547	546.0
Green	Green River	49.0	675	674.7
	Nolin	269.0	515	516.0
	Barren River	52.0	552	546.0
	Rough River	50.0	495	494.1

For the week of July 9, 2007, reservoir levels remain below the normal summer pool elevation at Taylorsville Lake in Spencer County, Barren River Lake in Barren County, Rough River Lake in Breckinridge County and Grayson Lake in Carter County. Lake levels and outflows are good indicators of moderate to severe drought conditions in these areas. It is noteworthy that both Barren River and Rough River lakes have been at or near the minimum release since mid-March, further evidence that the current drought conditions have been under development for some time.

Small Lakes and Water Supply Reservoirs

Water suppliers who rely on small reservoirs are acutely aware of any deviation from normal when it comes to the amount of water in their reservoir. As with the larger USACE projects, these small reservoirs are susceptible to drought impacts that can inhibit the "refilling" or "recharge" over winter and through the spring. In addition, the daily withdrawal of water for water supply can accelerate the drop in water levels so that the ability to withstand long periods of little or no precipitation is compromised.

The Division of Water will monitor selected small water supply reservoirs when conditions indicate that water supplies may be threatened by persistent drought. For the week of July 9, 2007, no reports of abnormally low reservoir levels have been reported.